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The Halogen Demand of Commercial Beverage Powders, Drinks and their Constituents

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The chlorine and iodine demands of commercially available synthetic beverage mixes and drinks were determined using an amperometric titrator. The major components of these drinks were also assayed individually for their halogen demand. All commercially available drinks were found to exert extremely high halogen demand to the point where they would neutralize most of the chlorine and iodine present, leaving no residuals for disinfection. The components of these drinks varied in their ability to react with chlorine and iodine. Based on these results, four in-house drink formulations were developed with

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components having little or no halogen demand.

PREFACE

The iodine water purification tablet (NSN 6850-985-7166) was first introduced into the military supply system in 1951. Although some minor changes to the specification have been made since that time, the tablet has proven to be an effective universal canteen disinfectant. This tablet is issued to the isolated soldier to enable him to produce canteen quantities of potable water from indigenous sources in the field when bulk water normally treated and supplied by the Engineers is not available.

Earlier studies have shown that commercial synthetic beverage powders available during and after World War II were not compatible with iodine treated water because of their high halogen demand. In the present concept to find ways of increasing water consumption by personnel stationed in the desert environment, it became necessary to confirm if currently available synthetic beverage formulations also exert high halogen demand. In order to make these determinations, a cooperative study was undertaken between the Environmental Protection Group and the Food Acceptance and Food Senses Group (FA & FS) of the Science and Advanced Technology Laboratory (SATL), NLABS in support of ILIR No. 132057131 and Project No. 1L162724AH99, Cost Code 23225708006 during the period 23 June - 21 September 1981. This report describes procedures undertaken to make these determinations. We thank Mrs. Barbara L. Sandick, FA&FS, SATL for supplying many of the beverage powders and their ingredients used throughout this study.

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INTRODUCTION

In the desert environment, an active combat soldier requires a daily intake of about 17 liters of water/day.[1] Under these conditions the thirst sensations are not strong enough to maintain body water balance, and intake may only serve to replace one-half of water losses. To avoid dehydration, some form of forced drinking is usually prescribed. A less severe suggestion to avoid dehydration is to make the indigenous pick-up water more palatable so that the men will voluntarily drink more water. While acceptability of water in the desert environment is influenced by several factors, one way to make it more palatable is by adding a flavoring agent to the water to mask unpleasant tastes and odors contributed to the water by naturally decomposing organic material and by other inorganic chemicals present in the water. Naturally occurring organic material present in pick-up water obtained from streams, lakes, etc., are known to impart objectionable tastes and odors to the water and to exert a halogen demand. This can be defined as the difference between the concentration of titratable halogen (chlorine or iodine) added and the titratable halogen remaining at the end of a given contact period or disinfection time. Consequently, prior to the proposed routine use of synthetic beverage mixes to make canteen water more palatable and to stimulate water consumption, it is necessary to know if these mixes will adversely affect the halogen level to the degree that the residual amount of iodine or chlorine present falls below the effective concentrations necessary to guarantee water disinfection. This report describes a study undertaken to answer this question.

[1] U.S. Army Operational Concepts Near Term Water Resources Management. TRADOC Pamphlet 525-11. 15 June 1981.

In the development of the present iodine purification tablet for canteen water,[2] it was determined that synthetic beverage powders containing flavoring oils, acid buffers and vitamin C (ascorbic acid) exert such a high halogen demand that they should never be mixed with water until the iodine or chlorine disinfectants have had time to act. Over the years we have cautioned against the use of flavoring agents or beverage powders with iodine-treated canteen water. Despite these warnings, Hurst and Bird[3] reported that of 139 U.S. Marines questioned in Vietnam in 1968, over two-thirds of them were adding some type of soft drink mixture to their canteen water to improve its palatability. In a 1977 paper, Rogers *et al.*,[4] reemphasized that military personnel should be warned to follow the prescribed time of contact for the iodine tablet before adding a beverage powder.

The objective of this study was to determine if any of the currently available commercial beverage drinks or mixes was exempt from this halogen demand. The necessity of providing potable drinking water to protect troop health against the various water-borne diseases takes precedence over any flavoring additive which may make the water more palatable. Any beverage drink powder or mix to be added to iodinated canteen water must, out of necessity, be added after the iodine tablet has been in contact with the water for 20 to 30 minutes unless it is determined that it does not exert any significant halogen demand or interfere with the essential water disinfection process.

[2] Fair, G. M. 1945. Disinfection of Water and Related Substances. Final Report to Medical Research and Development on Investigations Pursued from 1 Oct 1942-31 Dec 1945 under contract no. OEMCMS-251 between the Office of Scientific Research & Development and Harvard University.

[3] Hurst, N.S. and J. S. Bird. The Effect of Selected Soft Drink Mixes on the Germicidal Properties of Iodine Tablets. Bureau of Medicine and Surgery, Navy Department. XVIII, 1968.

[4] Rogers, M.R., J.J. Vitaliano, A.M. Kaplan and E. Pillion. 1977. Military Individual and Small Group Water Disinfecting Systems:An Assessment. Military Medicine.141:268-277.

MATERIALS AND METHODS

I. Chlorine Demand

A. In order to determine the chlorine demand of the samples tested, a liquid stock solution of approximately 1000 mg/L $Ca(OCl)_2$ was prepared from solid $Ca(OCl)_2$ stored in vacuum-sealed glass vials obtained from a military Chlorination Kit, 6850-270-6225, (Contract No. 019120-619, Mfd. by Sunlight Chemical Corp., Lot A5/61). From this stock $Ca(OCl)_2$ solution, 10mL or 20mL was added to two quarts of distilled water (equivalent to 5 or 10mL/qt, respectively).

B. The first quart of chlorinated water was used to determine total residual chlorine levels using a Wallace & Tiernan Amperometric Titrator (phenylarsene oxide method).

C. The second quart of chlorinated water was used for dissolving the beverage powders and for chlorine demand determinations. Amperometric titrations of this sample were made after 5, 10, 15, and 20 minutes or until all of the residual chlorine was gone.

D. For liquid beverage formulations such as Gatorade,* 5 or 10mL of the stock $Ca(OCl)_2$ was added to one quart of distilled water for dose determination followed by the additions of 5 or10mL of the stock $Ca(OCl)_2$ to the beverage for chlorine demand determinations.

II. Iodine Demand

A. In order to determine the iodine demand of each sample tested, 4 or 20 iodine tablets ** (equivalent to 2 or 10 iodine tablets/quart, respectively) were dissolved in 2 quarts distilled water. The same method as in IA and IC was used except the titrator method was modified for iodine determination.

* a product of Stockely-Van Camp, Inc.

** Water Purification Tablets, Iodine, NSN 6850-985-7166 mfd. by Wisconsin Pharmacal, Inc. or Van Brode Milling Co., Inc.

B. For liquid beverage formulation, 32 iodine tablets were dissolved in 1 liter of distilled water to produce a stock solution of approximately 256 mg/L I_2. Sixty mL of this stock solution (≈15.36 mg I_2/L) were added to one quart of the liquid beverage for iodine demand determination. Amperometric titrations of this sample were made at 5, 10, and 20 minutes or until all of the residual iodine was gone.

III. All titrations were made with a Wallace and Tiernan Titrator using the commercial reagents available from Wallace and Tiernan, Inc.

IV. All beverages and their constituents were prepared at the recommended use levels unless otherwise indicated.

V. Metric designations have been used throughout this report except where directions for use of commercial beverage powders specify quarts in place of liters.

Samples Tested

1. Commercial Formulated Beverage Powders

   1 Wylers' Chicken Flavor Bouillon

   2 Country Time Lemonade

   3 Cherry Kool-Aid

   4 Quenchade

   5 Tang

   6 Quickick

   7 Hawaiian Punch Drink Mix, Red Punch w/New Flavor Crystals

   8 Nestea Iced Tea Mix, Low Cal

   9 Nestea Iced Tea Mix

   10 Lemon-Lime Gatorade (Ready Made)

   11 Lemon-Lime Gatorade (Powder)

   12 Orange Gatorade (Powder)

2. Acids

13 Citric Acid

14 Ascorbic Acid

3. Buffers

15 Monocalcium Phosphate

16 Dicalcium Phosphate

17 Tricalcium Phosphate

18 Monosodium Phosphate

19 Disodium Phosphate

20 Trisodium Phosphate

21 Potassium citrate

22 Sodium citrate

4. Coloring Agents

23 Red (IGA)

24 Blue (IGA)

25 Yellow (IGA)

26 Allura Red FD + C #40

5. Containers

27 Plastic cups -- soft throw-away type

28 Plastic cups -- hard reusable type

29 2-Qt Canteen

6. Preservatives

30 Potassium Sorbate

7. Flavoring Agents

31 Natural and Artificial Orange Juice Flavor Flav-o-Lok

32 Natural and Artificial Orange Juice #2656

33 Natural-Orange Juice Flavor N-Cased WONF

34 Oil of Orange

35 Natural and Artificial Orange mfd. Firminch

36 Artificial Orange Flavor SD T2578

37 Artificial Pina Colada Flavor

38 Artificial Strawberry

39 Artificial Apricot

40 Artificial Cream

41 Artificial Berry

42 Natural and Artificial Chocolate

43 Artificial Vanilla

44 Artificial Peanut Flavor

45 Artificial Vanilla Butter

46 Beta Artificial Butter Flavor

47 Artificial Custard

48 Lemon-Lime Gatorade (Powder)

49 Lemon-Lime Gatorade Flavor (Liquid)

50 Orange Gatorade Flavor (Powder)

51 Orange Gatorade Flavor (Liquid)

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53 N-Grape Fruit Flavor #1265

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RESULTS AND DISCUSSION

The chlorine and iodine demands of several commercial beverages were tested and the results are tabulated in Tables 1-A and 1-B. It was found that all of the commercial beverages tested in this study have high halogen demands. The stability of the chlorine and iodine controls (chlorine and iodine dissolved in distilled water) used in these tests and at the same concentration as used with the samples but without any added beverage formulation or component are reported in Table 12.

The components commonly found in these commercial beverages were then tested individually for halogen demand and these data are tabulated in Tables 2-A to 4-B and 6-A to 10-B. Citric acid (Table 2-A and 2-B) was found to have little halogen demand while ascorbic acid was found to have a high demand (as previously reported)[5]. The buffers (Table 3-A and 3-B, samples 15-22) were found to exert very little halogen demand except trisodium phosphate (sample 20) which did exert some iodine demand.

The coloring dyes (Table 4-A and 4-B, samples 23-26) displayed varying degrees of chlorine demand but showed very little iodine demand. The plastic drinking cups (Table 5-A and 5-B, samples 27-29) used in the tests were also found to have very little halogen demand while the EVA plastic canteen did show some halogen demand.

However, potassium sorbate (Table 6-A and 6-B, sample 30), a preservative used in Gatorade and other food/drink products was found to have both high

[5] Fair, G. M. . 1945. Disinfection of Water and Related Substances. Final Report to Medical Research and Development on Investigations Pursued from 1 Oct 1942 to 31 Dec 1945 under Contract No. OEMCMS-251 between the Office of Scientific Research and Development and Harvard University.

chlorine and iodine demand. Similarly, the flavoring agents (Table 7-A and 7-B, samples 31-56) showed high chlorine and iodine demand with a few exceptions. Artificial butter flavor, artificial peanut butter, and artificial apricot were among the few flavors to show reduced halogen demand. Since artificial apricot appeared to be the only fruit flavoring agent worthy of further testing, the iodine and chlorine demand tests were repeated but at lower concentrations of the flavorant as shown in Table 7-C and 7-D. The lower concentrations of this apricot flavor (0.4 and 0.2 g/qt) showed lesser halogen demand than when tested at 0.8 g.qt. (see Table 7-A and 7-B)

Sugars (see Tables 8-A and 8-B) were found to have varying responses to chlorine and iodine demand. For example, sucrose was found to have little chlorine and iodine demand while dextrose had high chlorine demand and moderate iodine demand. The artificial sweeteners also exerted very little halogen demand.

The halogen demand of some of the common electrolytes used in the synthetic drinks (see Tables 9-A and 9-B) show no halogen demand. Simillarly, fruit pulp simulators used in these drinks which are composed mainly of modified Tapioca also show resistance to chlorine and iodine demand (see Tables 10-A and 10-B).

Since most of the commerical drinks tested contain a variety of components that exercise a halogen demand (flavorant, color, ascorbic acid, preservatives, etc.), it should be noted that one or more of these components may exercise a halogen demand at the expense of the others. For example, Tang (sample 5) contains, among other things, natural orange flavor, vitamin C (ascorbic acid) and artificial color, all of which have been shown to have high halogen demands. No attempt was made in these studies to determine which of these three additives would react most readily with iodine or whether all three components equally

compete for the available iodine when it is added to water. However, it is known that when the equivalent of ten iodine tablets (76.6 mg I_2/L) are added to Tang, all of the iodine is consumed within five minutes with no iodine residual, thus indicating that the iodine demand had not been satisfied. The same high iodine demand was found when using the equivalent of two iodine tablets (see Table 1-B). This could mean, for example, that the color and flavoring agents were being preferentially attacked by the iodine and leaving behind the vitamin C to be attacked at a later point once the iodine demand of the former could be satisfied. Therefore, a residual of vitamin C in this case should not be interpreted as being resistant to iodine demand but rather because insufficient iodine was present to effect neutralization of vitamin C, despite, for example, the use of ten iodine tablets. In addition, it is obvious that the maximum recommended use, concentration of two iodine tablets/qt. is readily destroyed by one or more of these additives leaving behind no iodine residual for necessary disinfection. Thus, there is no practical way to meet the high iodine demand of commercially available synthetic drink mixes and at the same time provide the necessary iodine residual of 8-16 mg/L for water disinfection.

As a result of the above findings, four in-house drink formulations were developed with components having little or no iodine demand. Drink formulations as contained in samples 71-73 were suggested by B. Sandick, SATL/FA&FS and the apricot flavored drink formulation (sample 74) was suggested by this laboratory. The Sandick formulations are no-flavored drinks (see Appendix), while sample 74 is basically the same but flavored with an apricot flavor. All of these in-house formulations showed some chlorine demand (see Table 11-A), but showed relatively little iodine demand (see Table 11-B).

These studies showed that none of the commercially available beverage

drink mixes or powders can be safely added to iodine treated water without drastically compromising the effectiveness of the iodine tablet (and chlorine) as a disinfection agent. If it can be shown that troop discipline can guarantee that the commercial beverage powders won't be added to the canteen until after the 20-30 minute iodine contact time has elapsed, the use of these powders would be deemed an acceptable procedure. However, as shown by the Marine experience in Vietnam previously reported by Hurst and Bird (1968), it is doubtful that troop discipline can be effectively guaranteed to this degree, and it is more likely that the innovative G.I. will find a way to circumvent such discipline.

If it is determined that the easiest way to stimulate water intake by personnel stationed in the desert is by flavoring it, the first step in the process of finding an acceptable flavorant formulation is to ascertain that it has little or no halogen demand, and therefore does not interfere with normal disinfection qualities of iodine and chlorine. For example, although data collected by the Behavioral Sciences Division of SATL shows iced tea is the non-dairy, non-carbonated drink most preferred by G.I.'s followed by a series of fruit flavored drinks[6], these preferences may now be subject to further evaluation since this study showed that two commercially available iced tea mixes (see samples 8 and 9, Tables 1-A and 1-B) inactivated both chlorine and iodine immediately upon addition. Similar inactivation was found with the commercially available fruit flavored drinks. The incompatibility of most commercially available flavored mixes with the iodine tablet (and chlorine) indicates the necessity for further study of this problem in order to develop a dry drink mix or formulation that can be added to a canteen along with the iodine tablet that will provide a safe and acceptable drinking water flavorant substitute.

[6] Meiselman, H. L., D. Waterman and L. E. Symington. 1974. Armed Forces Food Preference. Tech. Report. 76-63. Food Sciences Laboratory, NARADCOM.

CONCLUSIONS AND RECOMMENDATIONS

Adding flavorants to stimulate water acceptability and palatability appears to be a feasible solution to the problem of increasing water intake. It is therefore recommended that further work be undertaken on the in-house formulations as well as other candidate salt formulations[7] to develop an item or items which will make pick-up water more palatable and at the same time be compatable with current halogen disinfection procedures. When it is determined that these experimental formulations do not interfere with the standard iodine/chlorine disinfection procedures, the acceptable formulations should then be screened by the Food Acceptance and Food Senses Group for the other variables involved in assessing water acceptability such as source of water, length of time water was stored, temperature of water at time of drinking, and effect of other dietary components.

These preliminary findings show that it may not be possible to formulate an acceptable beverage mix which does not produce some halogen demand. In that case, additional testing should be undertaken to ascertain that the residual chlorine/iodine is present in sufficient amounts to exert the kill of bacteria, cysts, and viruses necessary in field pick-up waters containing high mineral and organic content.

[7] Cardello, A. V. and C. Murphy. 1977. Magnitude Estimates of Gustatory Quality Changes as a Function of Solution Concentration of Simple Salts. Chemical Senses and Flavor. 2: 327-339.

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Hurst, N. S. and J. S. Bird. 1968. The Effect of Selected Soft Drink Mixes on the Germicidal Properties of Iodine Tablets. Bureau of Medicine and Surgery, Navy Dept. XVIII.

Meiselman, H. L., D. Waterman and L. E. Symington. 1974. Armed Forces Food Preferences. Tech. Report. 75-63. Food Sciences Laboratory, NARADCOM, Natick, MA.

Rogers, M. R., J. J. Vitaliano, A. M. Kaplan and E. Pillion. 1977. Military Individual and Small Group Water Disinfecting Systems: An Assessment. Military Medicine. 141: 268-277.

U.S. Army Operational Concepts Near Term Water Resources Management. TRADOC Pamphlet 525-11. 15 June 1981.

Table 1-A

Chlorine Demand of Commercial Beverage Powders [using $Ca(OCl)_2$]

Sample No.	Powder Used	Chlorine Dosage No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
1	Chicken Flavored Bouillon	5	5.72	0.0	-	-	-
		10	13.40	0.30	0.25	0.11	0.05
2	Country Time Lemonade	5	5.41	0.0	-	-	-
		10	11.18	0.0	-	-	-
3	Cherry (Art. Flavor) Kool-Aid	5	5.80	0.0	-	-	-
		10	11.42	0.0	-	-	-
4	Quenchade	5	5.75	0.0	-	-	-
		10	11.55	0.0	-	-	-
5	Tang	5	5.70	0.0	-	-	-
		10	11.80	0.0	-	-	-
6	Quickick	5	5.68	0.0	-	-	-
		10	11.55	0.0	-	-	-
7	Hawaiian Punch	5	5.68	0.0	-	-	-
		10	11.22	0.0	-	-	-
8	Nestea Iced Tea Mix	5	5.72	0.0	-	-	-
		10	10.98	0.0	-	-	-
9	Nestea Iced Tea Mix Low Cal	5	5.75	0.0	-	-	-
		10	11.25	0.0	-	-	-
10	Lemon-Lime Gatorade (Ready Made)	5	5.85	0.0	-	-	-
		10	11.52	0.21	0.11	0.15	0.10
11	Lemon-Lime Gatorade (Powder)	5	5.75	0.0	-	-	-
		10	11.40	0.0	-	-	-
12	Orange Gatorade (Powder)	5	5.72	0.0	-	-	-
		10	11.40	0.0	-	-	-

Table 1-B
Iodine Demand of Commercial Beverage
Powders (Using Iodine Tablets)*

Sample No.	Powder Used	Iodine Dosage/Qt No. Tablets	Iodine Dosage/Qt mg/L I_2	mg/L I_2 in Mixture After. 5 min	10 min	15 min	20 min
1	Chicken Flavored Bouillon	2	17.0	0.0	-	-	-
		10	75.2	15.8	10.7	6.77	3.37
2	Country Time Lemonade	2	16.3	0.0	-	-	-
		10	77.5	0.0	-	-	-
3	Cherry (Art. Flavored) Kool-Aid	2	16.9	0.0	-	-	-
		10	75.6	2.86	2.79	2.26	2.26
4	Quenchade	2	16.8	0.0	-	-	-
		10	77.3	0.0	-	-	-
5	Tang	2	17.8	0.0	-	-	-
		10	76.6	0.0	-	-	-
6	Quickick	2	15.2	0.0	-	-	-
		10	78.8	15.6	10.6	6.69	4.37
7	Hawaiian Punch	2	16.6	0.0	-	-	-
		10	100.9	0.0	-	-	-
8	Nestea Iced Tea Mix	2	15.5	0.0	-	-	-
		10	75.6	0.0	-	-	-
9	Nestea Iced Tea Mix Low Cal	2	16.6	0.0	-	-	-
		10	72.3	0.0	-	-	-
10	Lemon-Lime Gatorade (Ready Made)	2	15.6	9.02	7.09	5.91	5.08
		-	-	-	-	-	-
11	Lemon-Lime Gatorade (Powder)	2	17.5	0.0	-	-	-
		-	-	-	-	-	-
12	Orange Gatorade (Powder)	2	17.7	3.19	1.36	0.43	0.29
		-	-	-	-	-	-

* Water purification tablets, Iodine, 50, MIL-W-283, for treating water in canteens Lot 805, mfd. 7/80 by Wisconsin Pharmacal, Milwaukee, WI 53223

Table 2-A

Chlorine Demand of Acids [Using $Ca(OCl)_2$]

Sample No.	Acid and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
13	Citric Acid 7.95 g/Qt	5	5.42	3.65	3.60	3.52	3.52
		-	-	-	-	-	-
14	Ascorbic Acid 240 mg/Qt	5	5.72	0.0	-	-	-
		10	11.00	0.0	-	-	-

Table 2-B

Iodine Demand of Acids (Using Iodine Tablets)*

Sample No.	Acid and Concentration Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
13	Citric Acid 7.95 g/Qt	2	15.2	14.1	13.4	13.2	13.1
		-	-	-	-	-	-
14	Ascorbic Acid 240 mg/Qt	2	16.1	0.0	-	-	-
		10	70.0	0.0	-	-	-

* Water Purification Tablets, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151.

Table 3-A

Chlorine Demand of Buffers [Using $Ca(OCl)_2$]

Sample No.	Buffer and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
15	Monocalcium phosphate 1.50 g/Qt	5	5.72	5.60	5.62	5.60	5.59
		-	-	-	-	-	-
16	Dicalcium phosphate 1.50 g/Qt	5	5.75	5.75	5.70	5.72	5.65
		-	-	-	-	-	-
17	Tricalcium phosphate 1.50 g/Qt	5	5.62	-	-	-	5.55
		-	-	-	-	-	-
18	Monosodium phosphate 0.284 g/Qt	5	5.72	5.72	5.70	5.70	5.70
		-	-	-	-	-	-
19	Disodium phosphate 0.284 g/Qt	5	5.80	5.95	5.80	5.75	5.75
		-	-	-	-	-	-
20	Trisodium phosphate 0.284 g/Qt	5	5.80	5.80	5.80	5.80	5.78
		-	-	-	-	-	-
21	Potassium Citrate 2.835 g/Qt	-	-	-	-	-	-
		10	11.28	10.70	10.68	10.60	10.62
22	Sodium Citrate 0.567 g/Qt	5	5.70	5.70	5.70	5.70	5.70
		-	-	-	-	-	-

Table 3-B
Iodine Demand of Buffers (Using Iodine Tablets)*

Sample No.	Buffer and Concentration Used	Iodine Dosage/Qt No. Tablets	Iodine Dosage/Qt mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
15	Monocalcium phosphate 1.50 g/Qt	2	17.7	17.9	17.5	17.1	16.9
		-	-	-	-	-	-
16	Dicalcium phosphate 1.50 g/Qt	2	14.3	14.3	14.3	14.1	14.1
		-	-	-	-	-	-
17	Tricalcium phosphate 1.50 g/Qt	2	15.9	15.5	14.9	14.9	14.7
		-	-	-	-	-	-
18	Monosodium phosphate 0.284 g/Qt	2	17.2	17.2	17.2	17.2	17.2
		-	-	-	-	-	-
19	Disodium phosphate 0.284 g/Qt	2	16.7	16.7	16.3	15.9	15.2
		-	-	-	-	-	-
20	Trisodium phosphate 0.284 g/Qt	2	15.8	14.7	13.8	11.2	9.31
		-	-	-	-	-	-
21	Potassium Citrate 2.835 g/Qt	2	15.4	15.3	15.2	15.2	15.1
		-	-	-	-	-	-
22	Sodium Citrate 0.567 g/Qt	2	15.6	15.6	15.7	15.7	15.7
		-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151

Table 4-A

Chlorine Demand of Coloring Agents [Using $Ca(OCl)_2$]

Sample No.	Color and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
23	Red 8 drops/Qt	5	5.40	5.29	5.05	4.65	4.25
	33 drops/Qt	5	5.45	4.28	3.65	2.25	1.72
24	Blue 33 drops/Qt	5	5.72	5.01	4.75	4.55	4.28
	-	-	-	-	-	-	-
25	Yellow 8 drops/Qt	10	11.11	2.75	1.45	0.90	0.61
	33 drops/Qt	10	11.22	0.02	0.0	-	-
26	Allura Red #40	5	5.60	3.81	3.28	2.31	1.80
	0.05 g/Qt	-	-	-	-	-	-

Table 4-B

Iodine Demand of Coloring Agents (Using Iodine Tablets)*

Sample No.	Color and Concentration Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L in Mixture After: 5 min	10 min	15 min	20 min
23	Red 8 drops/Qt	2	15.7	15.2	14.9	14.9	14.5
	33 drops/Qt	2	15.2	14.4	14.3	14.3	13.6
24	Blue 33 drops/Qt	2	16.1	15.9	15.6	15.2	14.8
	-	-	-	-	-	-	-
25	Yellow 8 drops/Qt	2	16.1	16.1	16.1	16.0	15.9
	33 drops/Qt	2	15.8	14.5	14.2	13.6	13.5
26	Allura Red #40	2	14.0	13.2	12.4	12.2	12.2
	0.05 g/Qt	-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Phramacal, New Berlin, WI 53151

Table 5-A

Chlorine Demand of Containers [Using $Ca(OCl)_2$]

Sample No.	Container Used	Chlorine Dosage/QT No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
27	Plastic cup, Throw-away type	5	5.25	-	-	-	5.25
		-	-	-	-	-	-
28	Plastic cup, Hand-reusable	5	5.62	-	-	-	5.55
		-	-	-	-	-	-
29	2 Qt Collapsible Canteen	5	5.65	5.41	5.05	4.80	4.74
		-	-	-	-	-	-

Table 5-B

Iodine Demand of Containers (Using Iodine Tablets)*

Sample No.	Container Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
27	Plastic cup, Throw-away type	2	15.2	-	-	-	14.7
		-	-	-	-	-	-
28	Plastic cup, Hand-reusable type	2	15.7	-	-	-	15.5
		-	-	-	-	-	-
29	2 Qt Collapsible Canteen **	2	16.1	15.6	15.2	14.1	14.2
		-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmical, New Berlin, WI 53151

** Canteen, Water Collapsible, 2 quart capacity, MIL-C-43603 (Ethylene Vinyl Acetate)

Table 6-A

Chlorine Demand of Preservatives [Using $Ca(OCl)_2$]

Sample No.	Preservative and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
30	Potassium Sorbate 2 g/QT	5	5.72	3.35	2.55	1.45	0.76
	1 g/QT	5	5.72	4.38	3.75	2.78	2.18
	0.5g/QT	5	5.72	4.50	4.28	3.76	3.60

Table 6-B

Iodine Demand of Preservatives(Using Iodine Tablets)*

Sample No.	Preservative and Concentration Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
30	Potassium Sorbate 2 g/QT	2	16.5	3.51	1.11	0.07	0.0
	1 g/QT	2	16.1	6.52	4.01	2.22	1.15
	0.5 g/QT	2	15.8	10.10	6.87	4.94	3.40

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151

Table 7-A

Chlorine Demand of Flavoring Agents [Using $Ca(OCl)_2$]

Sample No.	Flavoring Agents and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
31	N&A Orange Juice Flavor	5	5.95	0.52	0.35	0.13	0.07
	Flav-o-Lok 0.5 g/Qt	10	11.32	2.71	1.60	0.90	0.50
32	N&A Orange Juice #2656	5	5.70	0.0	-	-	-
	1.0 g/Qt	10	11.21	0.10	0.05	0.05	0.05
33	N-Orange Juice Flavor	5	5.85	0.55	0.49	0.42	0.40
	N-cased WONF 1.0 g/Qt	10	11.31	0.91	1.05	0.98	0.98
34	Oil of Orange	5	5.80	1.05	0.60	0.25	0.05
	1.0 ml/Qt	10	11.60	4.87	4.15	3.70	2.40
35	N&A Orange Firminch Inc.	5	5.72	0.32	0.11	0.08	0.05
	0.8 g/Qt	10	11.12	1.80	1.21	0.42	0.16
36	Art. Orange Flavor .15 g/Qt	5	5.72	1.10	0.51	0.32	0.25
	S.D. T2578 0.05 g/Qt	5	5.70	2.47	2.45	2.15	1.85
37	Art. Pina Colada	5	5.72	0.15	0.12	0.15	0.10
	1.0 g/Qt	10	11.28	0.21	0.10	0.08	0.10
38	Art. Strawberry	5	5.71	0.00	-	-	-
	0.8 g/Qt	10	11.45	0.47	0.12	0.12	0.09
39	Art. Apricot	5	5.80	1.40	0.87	0.65	0.50
	0.8 g/Qt	10	11.32	5.82	5.22	4.95	4.65
40	Art. Cream	5	5.60	0.05	-	-	-
	0.8 g/Qt	10	11.21	0.11	0.05	0.05	0.0
41	Art. Berry	5	5.65	0.0	-	-	-
	0.8 g/Qt	10	10.90	0.05	0.03	0.03	0.02
42	N&A Chocolate	5	5.71	0.15	0.08	0.05	0.05
	0.8 g/Qt	10	10.85	0.70	0.05	0.02	-
43	Art. Vanilla	5	5.75	0.05	0.05	0.08	0.05
	1.25 g/Qt	10	10.90	0.12	0.10	0.10	0.05
44	Art. Peanut Flavor	5	5.80	4.61	4.52	4.28	4.28
	1.25 g/Qt	-	-	-	-	-	-
45	Art. Vanilla Butter	5	5.85	0.05	0.02	0.05	0.05
	1.25 g/Qt	10	11.08	0.05	0.05	0.02	0.02

Table 7-A (cont'd)
Chlorine Demand of Flavoring Agents [Using $Ca(OCl)_2$]

Sample No.	Flavoring Agents and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
46	Beta Art. Butter Flavor	5	5.72	4.42	4.18	3.95	3.82
	1.25 g/Qt	10	10.90	9.52	9.50	9.10	8.70
47	Art. Custard	5	5.40	1.82	1.44	0.91	0.42
	0.8 g/Qt	10	11.32	2.35	1.81	0.71	0.46
48	Lemon-Lime Gatorade	5	5.85	0.0	-	-	-
	Flavor 0.5 g/Qt	10	11.11	0.25	0.08	0.02	0.02
49	Lemon-Lime Gatorade	-	-	-	-	-	-
	Flavor 0.95 mL/QT	10	11.49	1.81	1.19	0.70	0.42
50	Orange Gatorade Flavor	5	5.90	0.42	0.30	0.30	0.28
	0.5 g/Qt	10	11.32	0.85	0.40	0.30	0.30
51	Orange Gatorade Flavor	-	-	-	-	-	-
	0.95 mL/QT	10	11.36	0.35	0.18	0.15	0.15
52	N&A Lemon Flavor	-	-	-	-	-	-
	0.5 g/Qt	10	11.25	3.35	1.85	1.05	0.85
53	N-Grape Fruit Flavor	-	-	-	-	-	-
	#1265 1.0 g/Qt	10	11.50	0.05	0.03	0.01	0.01
54	N-Grape Fruit Flavor	-	-	-	-	-	-
	N-cased #2699 1.0 g/Qt	10	11.31	1.91	0.88	0.53	0.41
55	Oil of Lime	-	-	-	-	-	-
	1.0 mL/Qt	10	11.42	0.0	-	-	-
56	Imitation Lemon	-	-	-	-	-	-
	1.0 mL/Qt	10	11.40	7.45	6.65	6.52	6.22

Table 7-B
Iodine Demand of Flavoring Agents (Using Iodine Tablets)

Sample No.	Flavoring Agent and Concentration Used	Iodine Dosage/Qt No. Tablets	Iodine Dosage/Qt mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
31	N&A Orange Juice Flavor *	2	14.5	6.48	4.22	2.69	1.72
	Flav-o-Lok 0.3 g/Qt	-	-	-	-	-	-
32	N&A Orange Juice #2656 *	2	16.5	4.73	2.51	1.43	0.90
	1.0 g/Qt	-	-	-	-	-	-
33	N-Orange Juice Flavor *	2	14.5	3.03	1.43	0.93	0.69
	N-Cased WONF 1.0 g/Qt	-	-	-	-	-	-
34	Oil of Orange *	2	16.6	4.65	2.50	1.61	1.07
	1.0 mL/Qt	-	-	-	-	-	-
35	N&A Orange Firminch *	2	15.1	7.52	4.12	2.58	1.72
	Inc 0.8 g/Qt	-	-	-	-	-	-
36	Art. Orange Flavor .15 g/Qt *	2	15.0	6.37	4.12	2.22	1.47
	0.05 g/Qt	2	16.1	12.9	10.7	9.34	8.81
37	Art. Pina Colada *	2	14.1	4.30	2.15	1.54	1.15
	1.0 g/Qt	-	-	-	-	-	-
38	Art. Strawberry **	2	15.0	0.0	-	-	-
	0.8 g/Qt	10	71.6	53.0	51.6	51.2	49.1
39	Art. Apricot **	2	13.8	7.41	5.62	5.55	5.26
	0.8 g/Qt	-	-	-	-	-	-
40	Art. Cream **	2	13.8	5.55	2.94	2.08	1.36
	0.8 g/Qt	-	-	-	-	-	-
41	Art. Berry **	2	15.8	10.2	7.34	6.16	5.05
	0.8 g/Qt	-	-	-	-	-	-
42	N&A Chocolate **	2	15.8	5.87	4.44	3.40	2.94
	0.8 g/Qt	-	-	-	-	-	-
43	Art. Vanilla **	2	14.5	1.15	0.18	0.07	0.0
	1.25 g/Qt	-	-	-	-	-	-
44	Art. Peanut Flavor **	2	13.8	13.8	13.8	13.8	13.2
	1.25 g/Qt	-	-	-	-	-	-
45	Art. Vanilla Butter **	2	15.8	2.43	1.07	0.65	0.36
	Flavor 1.25 g/Qt	-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 805, mfd. 7/80 by Wisconsin Pharmacal, Milwaukee, WI 53151

** Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmaca., New Berlin, WI 53151

Table 7-B (cont'd)
Iodine Demand of Flavoring Agents (Using Iodine Tablets)

Sample No.	Flavoring Agent and Concentration Used	Iodine Dosage/Qt No. Tablets	Iodine Dosage/Qt mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
46	Beta Art. Butter Flavor[c]	2	15.9	12.9	12.6	12.2	11.9
	1.25 g/Qt	-	-	-	-	-	-
47	Art. Custard[c]	2	15.8	9.38	6.37	4.65	3.40
	0.8 g/Qt	-	-	-	-	-	-
48	Lemon-Lime Gatorade[b]	5	5.85	0.0	-	-	-
	Flavor 0.5 g/Qt	10	11.11	0.25	0.08	0.02	0.02
49	Lemon-Lime Gatorade[b]	-	-	-	-	-	-
	Flavor 0.95 ml/Qt	10	11.49	1.81	1.19	0.70	0.42
50	Orange Gatorade Flavor[b]	5	5.90	0.45	0.30	0.30	0.28
	0.5 g/Qt	10	11.32	0.85	0.40	0.30	0.30
51	Orange Gatorade Flavor[b]	-	-	-	-	-	-
	0.95 mL/Qt	10	11.36	0.35	0.18	0.15	0.15
52	N&A Lemon Flavor[D]	-	-	-	-	-	-
	0.5 g/Qt	10	11.25	3.35	1.85	1.05	0.85
53	N-Grape Fruit Flavor[b]	-	-	-	-	-	-
	#1265 1.0 g/Qt	10	11.50	0.05	0.03	0.01	0.01
54	N-Grape Fruit Flavor[b]	-	-	-	-	-	-
	#2699 1.0 g/Qt	10	11.31	1.91	0.88	0.53	0.41
55	Oil of Lime[b]	-	-	-	-	-	-
	1.0 mL/Qt	10	11.42	0.0	-	-	-
56	Imitation Lemon[D]	-	-	-	-	-	-
	1.0 mL/Qt	10	11.40	7.45	6.65	6.52	6.22

b Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 805, mfd. 7/80, Wisconsin Pharmacal, Milwaukee, WI 53151

c Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 74-1, mfd. 3/74, Van Brode Milling Co., Clinton, MA 01510

Table 7-C

Chlorine Demand of Apricot Flavoring at Reduced Concentrations [Using $Ca(OCl)_2$]

Sample No.	Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
39	0.4 g/Qt	5	5.90	4.25	3.85	3.59	3.51
	0.2 g/Qt	5	5.78	4.62	4.42	4.35	4.25

Table 7-D

Iodine Demand of Apricot Flavoring at Reduced Concentrations (Using Iodine Tablets)*

Sample No.	Concentration Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
39	0.4 g/Qt	2	16.9	12.2	11.2	10.6	10.2
	0.2 g/Qt	2	15.8	13.8	13.4	13.3	13.1

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151

Table 8-A

Chlorine Demand of Sugars and Artificial Sweeteners [Using $Ca(OCl)_2$]

Sample No.	Sweetener and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
57	Sucrose	5	5.70	4.75	4.60	4.38	4.38
	100 g/Qt	-	-	-	-	-	-
58	Dextrose	5	5.95	2.81	1.83	1.72	1.46
	100 g/Qt	-	-	-	-	-	-
59	D-Levulose (Fructose)	5	5.75	3.65	3.30	3.01	2.87
	25 g/Qt	-	-	-	-	-	-
60	D-Xylose	5	5.75	3.15	2.85	2.66	2.45
	50 g/Qt	-	-	-	-	-	-
61	Sorbitol	5	5.75	0.90	0.90	0.90	0.98
	50 g/Qt	-	-	-	-	-	-
62	Mannitol	5	5.98	5.15	5.09	5.05	4.93
	50 g/Qt	-	-	-	-	-	-
63	Sodium Saccharin	5	5.75	5.55	5.49	5.50	5.50
	15.3 g/Qt	-	-	-	-	-	-
64	Sweet'n Low	5	5.95	5.40	5.31	5.17	5.08
	7.0 g/Qt	-	-	-	-	-	-
65	Glucose-Sucrose	-	-	-	-	-	-
	Syrup 85 g/Qt	-	-	-	-	-	-
66	Corn Syrup	5	5.70	1.65	1.70	1.35	1.35
	155 g/Qt	-	-	-	-	-	-

Table 8-B
Iodine Demands of Sugars and Artificial Sweeteners (Using Iodine Tablets) *

Sample No.	Sweetener and Concentration Used	Iodine Dosage/Qt No. Tablets	Iodine Dosage/Qt mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
57	Sucrose	2	16.3	14.5	14.1	14.0	13.7
	100 g/Qt	-	-	-	-	-	-
58	Dextrose	2	15.6	14.1	13.5	12.4	11.7
	100 g/Qt	-	-	-	-	-	-
59	D-Levulose (Fructose)	2	15.7	13.8	13.6	13.2	12.6
	25 g/Qt	-	-	-	-	-	-
60	D-Xylose	2	14.1	11.6	10.9	10.3	10.2
	50 g/Qt	-	-	-	-	-	-
61	Sorbitol	2	14.9	14.1	13.3	13.2	13.2
	50 g/Qt	-	-	-	-	-	-
62	Mannitol	2	13.6	13.2	13.2	13.4	13.3
	50 g/Qt	-	-	-	-	-	-
63	Sodium Saccharin	2	14.4	13.4	13.2	12.7	12.5
	15.3 g/Qt	-	-	-	-	-	-
64	Sweet'n Low	2	15.6	15.5	15.3	15.2	15.3
	7.0 g/Qt	-	-	-	-	-	-
65	Glucose-Sucrose	2	15.4	12.4	11.5	10.8	10.8
	Syrup 85 g/Qt	-	-	-	-	-	-
66	Corn Syrup	2	14.0	9.31	8.77	7.88	7.16
	155 g/Qt	-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot. .097, mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151

Table 9-A

Chlorine Demands of Electrolytes [Using $Ca(OCl)_2$]

Sample No.	Electrolyte and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10^2 min	15 min	20 min
67	Gatorade Electrolyte Mix 1.7 g/Qt	5	5.82	5.58	5.60	5.50	5.49
		-	-	-	-	-	-
68	NaCl 0.567 g/Qt	5	5.72	5.72	5.72	5.72	5.72
		-	-	-	-	-	-
69	KI 0.567 g/Qt	5	5.60	5.60	5.60	5.60	-
		-	-	-	-	-	-

Table 9-B

Iodine Demand of Electrolytes (Using Iodine Tablets)*

Sample No.	Electrolyte and Concentration Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L I_2 in Mixture After: 5 min	10^2 min	15 min	20 min
67	Gatorade Electrolyte Mix 1.7 g/Qt	2	15.9	15.9	15.9	15.9	15.9
		-	-	-	-	-	-
68	NaCl 0.567 g/Qt	2	16.3	16.3	16.3	16.0	16.1
		-	-	-	-	-	-
69	KI 0.567 g/Qt	2	17.0	17.0	17.0	17.0	17.0
		-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot. 1097, mfd 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151

Table 10-A

Chlorine Demand of Pulp Simulators

Sample No.	Pulp Simulator and Concentration Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
70	Modified Tapioca Starch 0.2 g/Qt	-	-	-	-	-	-
		10	11.70	11.70	11.40	11.40	11.40

Table 10-B

Iodine Demand of Pulp Simulators *

Sample No.	Pulp Simulator and Concentration Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
70	Modified Tapioca Starch 0.2 g/Qt	2	15.9	15.7	15.2	14.5	14.1
		-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151

Table 11-A

Chlorine Demand of Suggested Drink Formulations [Using $Ca(OCl)_2$]

Sample No.	Drink Formulation Used	Chlorine Dosage/Qt No. mls	mg/L Cl_2	mg/L Cl_2 in Mixture After: 5 min	10 min	15 min	20 min
71	Inhouse I w/**33 drops Red Coloring	5	5.42	3.65	2.80	2.32	1.80
		-	-	-	-	-	-
72	Inhouse I w/**8 drops Red Coloring	5	5.52	3.91	3.31	2.98	2.49
		-	-	-	-	-	-
73	Inhouse I w/** 0.05 g Allura Red #40	5	5.70	3.05	2.16	1.41	1.05
		-	-	-	-	-	-
74	Apricot Flavored Drink	5	5.75	3.32	3.10	2.78	2.55
		-	-	-	-	-	-

Table 11-B

Iodine Demand of Suggested Drink Formulations (Using Iodine Tablets)*

Sample No.	Drink Formulation Used	Iodine Dosage/Qt No. Tablets	mg/L I_2	mg/L I_2 in Mixture After: 5 min	10 min	15 min	20 min
71	Inhouse w/ 33 drops ** Red Coloring	2	15.2	14.4	14.3	14.3	13.6
		-	-	-	-	-	-
72	Inhouse w/ 8 drops** Red Coloring	2	15.7	15.2	14.9	14.9	14.5
		-	-	-	-	-	-
73	Inhouse w/0.05 g ** Allura Red #40	2	14.0	13.0	12.4	12.2	12.2
		-	-	-	-	-	-
74	Apricot Flavored Drink	2	14.4	11.5	10.7	10.5	10.0
		-	-	-	-	-	-

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097, mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 5315.

** Sandick's drink

Table 12

Controls in Distilled Water

Sample No.	Halogen Used	Halogen Dosage/Qt No. mls or Tablets		mg/L Halogen	mg/L Halogen in Mixture After: 5 min	10 min	15 min	20 min
75	Chlorine	5		5.72	5.72	5.72	5.72	5.70
		10		11.30	11.28	11.26	11.25	11.25
76	Iodine	2	*	15.6	15.5	15.3	15.2	15.3
		10	*	75.6	74.9	74.9	75.0	74.9

* Water Purification Tablets, Iodine, 50, MIL-W-283, for treating water in canteens, Lot 1097 mfd. 9/79 by Wisconsin Pharmacal, New Berlin, WI 53151

Appendix

Composition of Samples Tested

Sample No.

1 Wylers Chicken Flavor Bouillon Cubes (use as directed), mfd by Wyler Foods - C, Borden, Inc. Columbus, Ohio 43215. Ingredients: Salt, Chicken, Corn Syrup, Solids, Sugar, Chicken Fat, Monosodium Glutamate (Flavor Enhancers), Hydrolyzed Vegetable Protein, Onion Powder, Garlic Powder, Turmeric, Natural Flavorings, Corn Oil, Glycerol Mono-oleate and Propylene Glycol and BHA and BHT and Propyl Gallate and Citric Acid (preserves freshness) L-Cysteine Hydrochloride and Thiamine Hydrochloride (Flavor Enhancers).

2 Country Time Lemonade Flavor (use as directed). General Foods Corporation, White Plains, N.Y. 10625 U.S.A. Ingredients: Sugar, Citric Acid (Provides Tartness), Trisodium Citrate (Controls Acidity), Natural Lemon Flavor, Modified Corn and Tapioca Starches, Partially Hydrogenated Coconut Oil, Vitamin C, Artificial Color, Tricalcium Phosphate (Prevents Caking), BHA (Preserves freshness). mfd. Code 01911 ACTL

3 Cherry (Artificial Flavor) Kool-Aid (use as directed). General Foods Corporation White Plains, New York 10625, U.S.A. Ingredients: Citric Acid (Provides Tartness), Monocalcium Phosphate (controls acidity), Artificial Flavor, Vitamin C, Artificial Color, BHA (Preserves freshness) mfd. code P-62215.

Sample No.

4 Quenchade (use as directed). Marketed by Mueller Chemical Co., Inc. Prairie Du Sac, WI 53578 U.S.A. Ingredients: Sucrose, Glucose, Citric Acid, Salt, Potassium Bicarbonate, Natural Dehydrated Orange Juice, Artificial Flavor, Ascorbic Acid, Artificial Color. Contains FD&C Yellow #5 (19140) and FD&C Yellow #6 (15985). Contains Sugars. Not for use by diabetics without advice of a physician.

5 Tang (use as directed). General Foods Corporation P.O. Box 90 TJ White Plains, New York 10625 U.S.A. Ingredients: Sugar, Citric Acid (For Tartness), Maltodextrin (Provides Body), Calcium Phosphates (Regulate Tartness and Prevent Caking), Potassium Citrate (Regulates Tartness), Natural Orange Flavor, Vitamin C, Artificial Flavor, Cellulose and Xanthan Gums (Provide Body), Artificial Color (including FD&C Yellow No. 5), Vitamin A Palmitate BHA and Alpha-Tocopherol (Preservatives).

6 Quickick (use as directed). Mfd. under the authority of and for QK Corp. Baton Rouge, Louisiana 70816, Exclusive for Distribution by Craner Products, Inc. Gardner Kansas U.S.A. 66030. Made in U.S.A. Ingredients: Glucose, Citric Acid, Salt, 0.019% Sodium Saccharin, Sodium bicarbonate, Potassium Chloride, Sodium Orthophosphate, Calcium Chloride, Natural and Artificial Flavors, Artificial Color.

7 Hawaiian Punch Drink Mix, Red Punch w/new Flavor Crystals. Distributed by RJR Foods Inc. One Market Plaza, San Francisco, CA 94105. Manufacture Code R-CAAX2. Ingredients: Sugar, Dextrose

Sample No.

Citric Acid (Provides Tartness), Natural and Artificial Flavors, Sodium Citrate (Regulates Tartness), Dextrin, Tricalcium Phosphate (Prevents Caking), Vitamin C, Cellulose Gum (Adds Body), Partially Hydrogenated Coconut and/or Cottonseed and/or Soybean Oil.

8 Nestea Iced Tea Mix. The Nestle Company Inc., White Plains, N.Y. 10605. Ingredients: Sugar, Citric Acid, Instant Tea, Lemon and other Natural Flavors.

9 Nestea Iced Tea Mix, Low Calorie. The Nestle Company Inc., White Plains N.Y. 10605. Ingredients: Corn Syrup Solids, Tea Solids, Citric Acid. 3.5% Sodium Saccharin (non-nutritive), Sodium Citrate, Gum Arabic and Natural Lemon Flavor.

10 Lemon-Lime Gatorade (Ready Mix)
11 Lemon-Lime Gatorade (Powder)
12 Orange Gatorade (Powder).

Stokely-Van Camp Inc., 6815 East 34th St., Indianapolis, IN 46226. Phone 317-542-9291.

Ingredients: Water, Glucose, Sucrose, Citric Acid, Salt, Sodium Citrate, Sodium Phosphate, Potassium Citrate, Natural and Artificial Flavors, Ester Gum and Artificial Color (Contains FD&C Yellow No. 6).

13 Citric Acid

14 Ascorbic Acid

15 Monocalcium Phosphate

16 Dicalcium Phosphate

17 Tricalcium Phosphate

Sample No.

18 Monosodium Phosphate

19 Disodium Phosphate

20 Trisodium Phosphate

21 Tripotassium Citrate

22 Trisodium Citrate

23 Red, Blue and Yellow IGA Food Colors. Distributed by Independent
24
25 Grocer's Alliance Distribution Co., Chicago, IL 60631.
Contains: Water, Propylene Glycol, and Artificial Colors
(Red 2.8% min).

26 Allura Red FD&C #40. Buffalo Color Corporation. Buffalo, NY

27 Soft Throw-away Plastic Cups

28 Plastic Cups, Hand, Reusable Type Tumbler, Drinking, SI Lite,
Inc. mfd. Codes 7856-00 680-0645 and GS-095-38646 P.O. No.
D-W-SK220-1.

29 Soft Shell Water Canteen, 2/Qt Capacity, Contract No. DSA100-72-C-
1556 FSN #8465-927-7485.

30 Potassium Sorbate (Reagent Grade)

31 N&A Orange Juice Flavor Flav-o-Lok. 695005 PFW Inc., Middletown,
N.Y., U.S.A. A Division of Hercules, Inc.

32 Natural and Artificial Orange Juice D.B. No. 2656. Fragrance
and Flavor Materials. Synfleur, Scientific Laboratories, 585
Winters Ave., Paramus, N.J. 07652. A Subsidiary of the Nestle
Co., Inc.

33 Natural Orange Juice Flavor N-Cased WONF No. 2176. Synfleur,
Scientific Laboratories, 585 Winters Ave., Paramus, N.J. 07652.
A Subsidiary of the Nestle Co., Inc.

Sample No.

34 Oil of Orange, 2 Fold. Lot No. 8081. J. Mamheimer Inc., 47-22 Pearson Place, Long Island City, N.Y. 11101. For manufacturing and professional use only.

35 N&A Orange. Mfd. Code 57.690/AP0551, Firmenich Inc. Princeton, N.J.

36 Artificial Orange Flavor S.D. Mfd. Code T2578, International Flavors and Fragrances Inc., 600 State Highway 36, Hazlet, N.J. 07730.

37 6678 S.D. Artificial Pina Colada Flavor. Stepan Flavors, Stepan Chemical Co., 500 Academy Drive, Northbrook, Illinois 60062. Phone 1-(312)-291-8300. Mfd. Code SPN-5357-A.

38 Artificial Strawberry. Mfd. Code 52.312/AP 05.51, Firmenich Inc., Princeton N.J.

39 Artificial Apricot. Mfd. Code 52.247/APO 5.51, Firmenich Inc., Princeton, N.J.

40 Artificial Cream. Mfd. Code 59.200/AP05.51, Firmenich Inc., Princeton, N.J.

41 Artificial Berry. Mfd. Code 59.454/AP05.51, Firmenich Inc., Princeton, N.J.

42 N&A Chocolate. Mfd. Code 57.326/AP05.51, Firmenich Inc., Princeton, N.J.

Sample No.

43 Artificial Vanilla Flavor Powder. Mfd. Code 1349830, International Flavor and Frangrances Inc., 600 State Highway 36, Hazlet, NJ 07730. Mfd. 6/24/81.

44 Artificial Peanut Flavor Powder. Mfd. Code 13516802, International Flavors and Frangrances Inc., 600 State Highway 36, Hazlet, NJ 07730. Mfd. 6/24/81.

45 Artificial Vanilla Butter Flavor Powder. Mfd. Code 13516704, International Flavors and Frangrances Inc., 600 State Highway 36, Hazlet, NJ 07730. Mfd. 6/24/81

46 Beta Artificial Butter Flavor S.D. Mfd. Code 13508894, International Flavors and Frangrances Inc., 600 State Highway 36, Hazlet, NJ 07730 Mfd. 6/24/81.

47 Artificial Custard. Mfd. Code 52.940/AP05.51, Firmenich Inc., Princeton, NJ.

48 Lemon-Lime Gatorade Flavor (Powder).
49 Lemon-Lime Gatorade (Liquid).
50 Orange Gatorade Flavor (Powder).
51 Orange Gatorade Flavor (Liquid).

Stokely-Van Camp, Inc., 6815 E. 34th St., Indianapolis, IN 46226. Phone 317-542-9291

52 707853 S.D. Nat. & Art. Lemon Flavor. Stepan Flavors, Stepan Chemical Co., 500 Acadenary Drive, Northbrook, IL 60062. Phone 312-291-8300

Sample No.

53 Natural Grape Fruit Flavor, S.D. #1265. Synfleur, Scientific Laboratories Co., A Subsidiary of the Nestle Co., Inc., Monticello, N.Y. Made in U.S.A.

54 Nat. Grapefruit Flavor N-Cased #2699. Synfleur, Scientific Laboratories Co., Fragrance and Flavor Materials, A Subsidiary of the Nestle Co., Inc., 585 Winters Ave., Paramus, N.J. 07652.

55 Oil of Lime. Mfd. Code 0628715, Florasynth Inc., New York, Chicago and San Francisco.

56 Imitation Lemon Extract (Artificially Flavored). Durkee Famous Foods, SCM Corp., Cleveland, OH 44115, U.S.A. Contains: Alcohol 80%, Water, Oil of Lemon, Artificial Flavor and Certified Food Color.

57	Sucrose	Reagent Grade
58	Dextrose	
59	d-Levulose	
60	d-Xylose	
61	Sorbitol	
62	Mannitol	
63	Sodium Saccharin	

64 Sweet'n Low. Cumberland Packing Corp., Brooklyn, NY. 11205. Pat. No. 3625711. Ingredients: Nutritive dextrose 4%, Sodium Saccharin (40 milligrams per packet or 20 milligrams per each teaspoonful of sugar sweetening equivalency), Cream of Tartar and drier.

65 Glucose-Sucrose Syrup (50:50). Ingredient in ready-to-drink Gatorade. Stokely-Van Camp, Inc., 6815 East 34th St., Indianapolis, IN 46226. Phone 317-542-9291.

Sample No.

66 Karo Light Corn Syrup. Best Foods, CPC International Inc., N.J.
Ingredients: Light Corn Oil, Salt, Vanilla Fructose Corn Syrup.

67 Gatorade Electrolyte Blend. Ingredient in all U.S. Gatorade products. Stokely-Van Camp Inc., 6815 East 34th Street, Indianapolis, Indiana 46226. Phone 317-542-9291.

68 NaCl
69 KI } Reagent Grade

70 Modified Tapioca Starch/Food Grade

71 Inhouse[1] (Sandick) Formulation Ca 5 g Citric Acid, 100 g Sucrose/Qt C 33 drops IGA Red.

72 Inhouse[1] (Sandick) Formulation Ca 5 g Citric Acid, 100 g Sucrose /Qt C 8 drops IGA Red/Qt.

73 Inhouse[1] (Sandick) Formulation Ca 5 g Citric Acid, 100 g Sucrose /Qt C 0.05 g Allura Red FD & C #40/Qt.

74 0.2 g Apricot Flavor (Firmenich, Inc.), 50 g Sucrose, 2 g Citric Acid, 1 drop IGA Red/Qt.

[1]Inhouse Beverages were formulated by Barbara Sandick under ILIR No. 1320507131.